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REFRIGERATION & AIR CONDITIONING MECHANIC

AN OCCUPATIONAL PROFILE



Ministry of
Colleges and
Universities

Program
Resources
Branch

HEATING, REFRIGERATION & AIR CONDITIONING

REFRIGERATION AND AIR CONDITIONING MECHANIC

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The History of the Analysis

On February 15, 1974 as a result of a series of meetings between representatives of the Heating, Refrigeration and Air Conditioning Industry, the Government of Ontario and the Federal Government, agreement was reached to participate in a Canada-wide joint Industry Task Analysis Program.

The Program Resources Branch, Ontario Ministry of Colleges and Universities, accepted the responsibility of providing trained analysts to conduct the actual analysis within Ontario with the guidance of a steering committee selected from a cross-section of the industry and operating under the Chairmanship of Mr. W.F. Marshall of Marshall Refrigeration Co. Ltd.

The Program Resources Branch, Ministry of Colleges and Universities wishes to acknowledge the support and assistance of the following members of the H.R.A. Industry Analysis Steering Committee:

W.F. Marshall (Chairman)	Marshall Refrigeration Co. Ltd.
L. Cianfarani	Ontario Sheet Metal & Air Handling Group
P. Drabinsky	Techaire Systems Inc./O.R.A.C.
R.D. Fraser	H.R.A. Institute of Canada
G. Granek	G. Granek & Associates
J.W. Ingram	Shell Canada Ltd./O.P.A.
W. Podd	Mohawk College/R.S.E.S.
P.F. Reynolds	Jenkinson & Co. Ltd./ASHRAE
N.W. Walden	O.R.A.C.
D.R. Wheeler	Lennox Industries (Canada) Ltd./ HRAI

Scope of the Analysis

The analysis contains only those phases of the Industry considered essential in the Province of Ontario. It is limited to the body of knowledge and skills as outlined and agreed to by the Industry Analysis Steering Committee.

It was agreed that the analysis should be broad enough to cover the whole family of occupations which are representative of the Heating, Refrigeration and Air Conditioning Industry up to, but not including, professional or pure management levels. The scope of each of the occupational groups to be covered, including a general breakdown of the industry as defined by the Committee, is represented graphically by Fig. 1.

Fig. 1

HEATING		AIR CONDITIONING		REFRIGERATION	
Domestic		Automotive		Mobile	
Commercial		Residential		Marine	
Gas		Commerical/Residential		Commerical	
	Sheet Metal				
		Electrical			
		Plumbing			
MANUFACTURING		SYSTEM DESIGN	DISTRIBUTION	INSTALLATION AND SERVICE	
Applications Tech.	Design Consultant	Applications Tech.	Applications Tech.	Applications Tech.	
Sales Tech.	Estimator	Sales Tech.	Estimator	Estimator	
Telephone Order Desk	Design Draftsman	Purchasing	Sales Tech.	Sales Tech.	
		Order Desk	Field Inspector	Field Inspector	
		Counteraman	Mechanic	Mechanic	
		Order/Picker and/or Stockman	Purchasing	Purchasing	
			Service Order Desk	Service Order Desk	

Objectives

Although one of the essential aims of this industry/government project is to establish an Ontario standard, it is expected that a number of equally important benefits will be provided such as:

- a basis for effective training to meet the needs of all levels of the industry in order that industry's training resources may be utilized more effectively;
- a career plan with various entry and exit levels to meet individual requirements;
- a basis for common training programs across Canada with a national standard of certification;
- a means for counselling students and attracting young people into a fast growing segment of the economy;
- a means of improving communications between industry and government on training matters.

Statement of Method

The survey, conducted by field analysis teams supervised by Mr. G.I. Bruce, Senior Training Consultant, commenced in the fall of 1974. By means of personal interviews with industry management and employees, the individual tasks comprising each occupation were determined.

The analysis teams, coordinated by G.F. Starink, asked such questions as:

- What does the worker do?
- How does the worker do it?
- Why is he/she doing it?
- What are the skills and knowledge involved?
- What is the minimum acceptable standard of performance expected?

The goals established were to determine which occupations make up the industry, to describe them in terms of performance objectives and performance standards and through these "occupational profiles" to produce a structured training progression.

Data from Statistics Canada was used to determine the population (i.e. companies) distribution for H.R.A. Industries in Ontario. A representative sample, from which valid and reliable data could be extracted, was established with the aid of the Steering Committee using agreed upon guidelines to cover significant differences for: - geographical distribution on a north/south basis; establishment size (1-10 and 11 plus); number and types of companies within each of the heating, refrigeration and air conditioning segments of the industry.

In the Industry sample encompassing over 50 companies across Ontario approximately 100 interviews were conducted and the resultant data recorded.

A task analysis of this data resulted in a consolidation of occupations from the 57 titles found within the industry to the 12 major occupations submitted to the Steering Committee in mid 1975.

The order of completion of the occupational profiles will be in accordance with priorities established by the Steering Committee.

Occupational Profiles

The following occupational profiles have been accepted by the Steering Committee. Occupations not indicated as completed are subject to on-going modification in title and content subject to approval by the committee.

Each profile is a description of the occupation in terms of performance objectives and performance standards for Ontario.

- Refrigeration & Air Conditioning Mechanic
(Completed Dec./75)
- Counterman H.R.A.
(Completed Jan/76)
- Warehouseman H.R.A.
(Completed Jan./76)
- Salesperson
- Heating Serviceman - Gas & Oil
- Design Draftsman (Intermediate, Junior)
- Designer (Technician)
- Designer (Technologist)
- Dispatcher
- Estimator
- Order Desk Clerk
- Purchasing Agent

REFRIGERATION AND AIR CONDITIONING MECHANIC

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SPECIFIC PERFORMANCE OBJECTIVES AND CRITERIA FOR : REFRIGERATION AND AIR CONDITIONING MECHANIC			CCDO No.
TERMINAL PERFORMANCE OBJECTIVES : To be able to...	ENABLING OBJECTIVES : Will be able to...	TERMINAL PERFORMANCE CRITERIA : Minimum acceptable standard...	
<p>READ:</p> <ul style="list-style-type: none"> - Building working drawings, specifications and contracts - Schematics - Charts, graphs and tables 	<ul style="list-style-type: none"> - Identify and interpret: <ul style="list-style-type: none"> - numerical values and their associated units - dimensions - the title block and scale - orthographic projections - pictorial drawings - abbreviations, signs and symbols - Interpret critical path analysis charts and extract necessary times for completion dates and starting dates for the various stages of a job - Identify and interpret the following data on psychrometric charts: <ul style="list-style-type: none"> - dry-bulb temperature - wet-bulb temperature - relative humidity - pressure - dewpoint - grains of moisture - Identify and interpret the following refrigerant properties: <ul style="list-style-type: none"> - thermodynamic - material - Identify and interpret the following data on service charts: <ul style="list-style-type: none"> - symptoms - causes - corrections - references 	<ul style="list-style-type: none"> - Read prints, schematics and diagrams and extract the data required to: <ul style="list-style-type: none"> - determine installation procedures of <ul style="list-style-type: none"> - built-up systems - packaged systems - determine the mounting area and establish the method of mounting a unit - determine wiring layout - determine piping layout of the following lines: <ul style="list-style-type: none"> - refrigerant - secondary refrigerant - water - oil - drain - defrost - calculate air conditioning and refrigeration loads - troubleshoot and repair the system - calculate required materials - plan work progress in conjunction with other trades - Read graphs, charts and tables and extract the data required to: <ul style="list-style-type: none"> - select replacement units, estimate factors - size refrigerant and air handling equipment units - check air and refrigerant properties and operating parameters against design estimates 	

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	<ul style="list-style-type: none"> - Identify and interpret data for: <ul style="list-style-type: none"> - specific heat - temperature, pressure and humidity - design temperature coefficients - heat transfer coefficients - Identify and interpret data for the selection, sizing or checking of: <ul style="list-style-type: none"> - tools and hardware - wiring and piping - replacement parts <p>such as:</p> <ul style="list-style-type: none"> - capacities and maximums - recommendations - coefficients - differentials - correction factors - relationships (temp/pressure/enthalpy) 		

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<p>SELECT:</p> <ul style="list-style-type: none"> - HARDWARE <p>of the following types:</p> <ul style="list-style-type: none"> - nails - screws - nuts and bolts - staples - washers - clips and pins - rivits - latches - hinges - strikers 	<ul style="list-style-type: none"> - Read charts and drawings - Identify the various types and applications of hardware - Select the correct piece of hardware based upon: <ul style="list-style-type: none"> - size - type - length - application for the following materials: <ul style="list-style-type: none"> - metals - wood - concrete - of various thicknesses 	<p>Select the correct hardware for an application based upon:</p> <ul style="list-style-type: none"> - size - type - length <p>for various materials</p>	

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<p>SELECT AND USE:</p> <ul style="list-style-type: none"> - HAND TOOLS of the following types: <ul style="list-style-type: none"> - screwdrivers - wrenches - Allen keys - scrapers and chisels - metal and wood saws - files and reamers - pliers - pipe cutting, flaring and bending tools - hammers - cutters and shears - drifts and punches - taps and dies - clamps and vises 	<ul style="list-style-type: none"> - Identify the types of hand tools specified in terms of their: <ul style="list-style-type: none"> - size and shape - applications to specific materials - strength capacity - operating range - Determine the methods of assembling and adjusting the necessary hand tools - Read charts and tables - Identify the number and symbol classification - Store and maintain tools - Determine the type of fasteners or work materials on which the tools will be applied - Determine the methods of applying the hand tools for: <ul style="list-style-type: none"> - safe operation - restricted operations - the most efficient use to perform the following operations: <ul style="list-style-type: none"> - threading - holding - fastening - cutting - material removal 	<p>Hand tools must be correctly selected as to the:</p> <ul style="list-style-type: none"> - type - size and shape - capacity <p>For:</p> <ul style="list-style-type: none"> - the type of operation to be performed - the type of material to be used - the dimensional restrictions in which to operate - the necessary force to be applied - the operating rate - the most efficient usage <p>All operations involving the application of hand tools will be performed efficiently and safely.</p>

SPECIFIC PERFORMANCE OBJECTIVES AND CRITERIA FOR :

REFRIGERATION AND AIR CONDITIONING MECHANIC

CCDO No.

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<p>SELECT AND OPERATE: - POWER TOOLS</p> <p>of the following types:</p> <ul style="list-style-type: none"> - electric drills - electric hammers - power saws - impact wrenches - powder-activated stud tools - power grinders - pipe cutting and threading machines 	<ul style="list-style-type: none"> - Read prints, charts and tables - Identify the specified power tools based upon: <ul style="list-style-type: none"> - types and sizes - application - operating range - Select the accessories, such as blades and bits, based upon: <ul style="list-style-type: none"> - the specified types, sizes, applications and tolerances - the materials to be worked upon - Identify the accessories by the number and symbols - Attach the accessory to the power tool - Determine the correct method to power the tools based upon: <ul style="list-style-type: none"> - voltage and amperage requirements - Handle, maintain, adjust and store: <ul style="list-style-type: none"> - the accessories - the power tools - Determine the methods to operate power tools for: <ul style="list-style-type: none"> - safe operation - restricted operations - based upon: <ul style="list-style-type: none"> - the type of operation - the type of material - the operating rate 	<p>Power tools must be selected as to the:</p> <ul style="list-style-type: none"> - types - sizes - operating ranges <p>Accessories must be selected based upon:</p> <ul style="list-style-type: none"> - the types, sizes, applications and tolerances - the materials to be worked upon <p>All operation of power tools will be performed efficiently and safely</p>

SPECIFIC PERFORMANCE OBJECTIVES AND CRITERIA FOR : REFRIGERATION AND AIR CONDITIONING MECHANIC C C D O No.		
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<p>OPERATE:</p> <ul style="list-style-type: none"> - GAS WELDING EQUIPMENT 	<ul style="list-style-type: none"> - Read charts and tables to: <ul style="list-style-type: none"> - select proper tip - determine pressure setting of: <ul style="list-style-type: none"> - oxygen - acetylene - determine ratio between oxygen and acetylene - Select and operate necessary tools for: <ul style="list-style-type: none"> - assembly - adjustment - disassembly - Identify gas according to colour coding - Connect the following: <ul style="list-style-type: none"> - gas cylinder - regulators - gauges - hose assemblies - torches and tips - Apply safety measures: <ul style="list-style-type: none"> - by wearing protective clothing including: <ul style="list-style-type: none"> - leather gauntlets - aprons - coveralls - head projection - shaded goggles - by working in ventilated areas and use of face respirators - by using screens to enclose area - when igniting torches - to store and handle cylinders containing gas 	<p>The gas welding equipment must be assembled for operation. All connections must be tight and leakproof and the equipment must be positioned to allow for safe and efficient operation.</p> <p>Operate the gas welding equipment by igniting and adjusting the torch to produce the following flames:</p> <ul style="list-style-type: none"> - neutral - carbonizing - oxidizing <p>The equipment must be shut-down to ensure no pressure present beyond the cylinder shut-off valve.</p> <p>The equipment must be safely stored after disassembly.</p> <p>Safety measures will be strictly adhered to for all operations.</p>

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	<ul style="list-style-type: none"> - Read gauges - Adjust torch for the following flames: <ul style="list-style-type: none"> - neutral - carbonizing - oxidizing - Apply proper procedure for shut-down and bleeding of gas welding equipment - Disassemble, store and safely handle gas welding equipment 	

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BRAZE WELD, BRAZE AND SOLDER	<ul style="list-style-type: none"> - Operate gas welding equipment of the following types: <ul style="list-style-type: none"> - oxyacetylene - propane - Read charts and tables - Select proper torches and tips for: <ul style="list-style-type: none"> - braze welding - brazing - soldering for various types, shapes and sizes of material - Apply techniques of basic weld joints - Select proper filler metals and apply to correct areas - Determine correct adjustment for: <ul style="list-style-type: none"> - amount of heat - flame size - type of flame - Apply flux at correct speed - Select and operate necessary tools, solvents, and cleaning materials for: <ul style="list-style-type: none"> - preparing the workpiece - securing the workpiece - Position the flame for a clean, efficient, secure joining of the workpiece - Apply techniques for flat and horizontal position braze welding 	<p>The workpiece must have a clean appearance and be free of porosity.</p> <p>The joint must be uniformly penetrated with a minimum amount of filler metal, and to be finished smooth.</p> <p>The workpiece must surpass visual and non-destructive test</p> <p>Safety will be adhered to for all operations.</p>	

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RIG LOADS AND SIGNAL	<ul style="list-style-type: none"> - Determine load weights - Read charts and tables of standard slings and tackle - Select the slings and tackle required for their proper applications based upon: <ul style="list-style-type: none"> - type - size - shape - weight - Check slings and tackle for deterioration - Maintain and store slings and tackle - Communicate visually using the standard approved hand signals for: <ul style="list-style-type: none"> - hoist load - lower load - raise boom - lower boom - raise the boom and lower the load - lower the boom and raise the load - stop - emergency stop - dog everything - use main hoist - use whip line (auxiliary hoist) - move slowly - swing - hoist slowly to clear fouled line - extend boom - retract boom 	<p>The load must be securely rigged according to:</p> <ul style="list-style-type: none"> - type - size - shape - weight <p>Hand signals for the hoisting operation must be correctly applied and recognized without error.</p> <p>Good safety practice for rigging and hoisting must be strictly adhered to for each application.</p>		

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	<ul style="list-style-type: none"> - Determine the proper location for a signalman - Apply safety measures by: <ul style="list-style-type: none"> - wearing protective clothing and special apparel for signalman 		

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HOIST: - LOADS using small portable hoists including: - pulleys - cranes - jacks	<ul style="list-style-type: none"> - Rig loads and interpret hand signals - Identify all controls and gauges of hoist - Determine the effect of fast raising or lowering a load on the load carrying capacity - Determine recommended maximum wind velocity - Hoist balanced and unbalanced load based upon: <ul style="list-style-type: none"> - type - weight - shape - size - Determine techniques of load control - Apply safety measures: <ul style="list-style-type: none"> - by wearing protective clothing - Perform preoperation and post-operation inspection of hoist for: <ul style="list-style-type: none"> - maintenance routine for hoists - deterioration of slings and cables 	<p>The load must be safely raised and lowered to clear all machinery and equipment without shocks or slippage of load.</p> <p>The load must be moved at a uniform speed to prevent swinging.</p> <p>Hand signals for every hoisting operation must be quickly interpreted without error.</p> <p>Good safety practice for hoisting must be strictly adhered to for each application.</p>	

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<p>SELECT:</p> <ul style="list-style-type: none"> - ELECTRICAL MEASURING INSTRUMENTS <p>of the following types:</p> <ul style="list-style-type: none"> - voltmeters - ammeters - ohmmeters - wattmeters - multimeters - ground detectors - meggers - recorders - capacitor analyzers 	<ul style="list-style-type: none"> - Read prints, diagrams, schematics and charts - Identify the various types and applications of electrical measuring instruments - Select the accessories required for their proper operation - Select the correct measuring instruments based upon: <ul style="list-style-type: none"> - the respective application to: <ul style="list-style-type: none"> - detect current flow and direction - check continuity - check 3-phase circuits - check and measure voltage (AC-DC), amperage (AC-DC), resistance and power - measure insulation resistance - check capacitors - the instrument's limitations vis-a-vis: <ul style="list-style-type: none"> - measuring range - scale values - sensitivity - resolution and precision 	<p>Select an electrical measuring instrument based upon:</p> <ul style="list-style-type: none"> - its respective application - its limitations <p>to check and measure AC-DC circuits and components</p>

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OPERATE : - ELECTRICAL MEASURING INSTRUMENTS of the following types: - voltmeters - ammeters - ohmmeters - wattmeters - multimeters - ground detectors - meggers - recorders - capacitor analyzers	<ul style="list-style-type: none"> - Read prints, diagrams and symbols - Adjust measuring instruments - Select correct range and scale - Connect the instrument: <ul style="list-style-type: none"> - across the electrical circuit or component - in series in the circuit - by induction - Interpret meter readings by giving correct value and unit of measurement - Handle and maintain the electrical measuring instrument 	Operate a electrical measuring instrument to check AC-DC circuits. Range selector must be set prior to connections; connections must ensure optimum electrical contact. Readings will have correct value and unit of measurement to a specified accuracy.	

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<p>SELECT:</p> <ul style="list-style-type: none"> - MECHANICAL MEASURING INSTRUMENTS of the following types: <ul style="list-style-type: none"> - tapes and rules - spirit levels - straight edges, squares and protractors - plumb bobs - chalk lines - vernier callipers - micrometers - callipers and dividers - feeler gauges - screw thread gauges - weight scales 	<ul style="list-style-type: none"> - Read prints and diagrams - Identify the various types and applications of instruments - Select the measuring instrument based upon: <ul style="list-style-type: none"> - its respective application: - to measure inside and outside dimensions - to check straightness and levelness - to determine weights - the size and shape of the object or surface - the selected unit of measurement based upon: <ul style="list-style-type: none"> - the British system - the Metric system - the instrument's limitations vis-à-vis: <ul style="list-style-type: none"> - the range - the scale values - the resolution - the tolerance 	<p>Select a mechanical measuring instrument based upon:</p> <ul style="list-style-type: none"> - the type and size - the application to: <ul style="list-style-type: none"> - measure - align - test - check - weigh objects and surfaces - the instrument's limitations

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<ul style="list-style-type: none"> - OPERATE: - MECHANICAL MEASURING INSTRUMENTS of the following types: <ul style="list-style-type: none"> - tapes and rules - spirit levels - straight edges, squares and protractors - plumb bobs - chalk lines - vernier callipers - micrometers - callipers and dividers - feeler gauges - screw thread gauges - weight scales 	<ul style="list-style-type: none"> - Read prints and diagrams - Adjust measuring instrument - Measure, align, test, check and weigh objects and surfaces - Interpret reading by giving correct value and unit of measurement - Handle, maintain and store the instrument 	<p>Operate mechanical measuring instruments to:</p> <ul style="list-style-type: none"> - measure - align - test - check - weigh <p>objects and surfaces</p>	

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<p>SELECT:</p> <ul style="list-style-type: none"> - TEST INSTRUMENTS <p>of the following types:</p> <ul style="list-style-type: none"> - hydrometers and moisture indicators - salometers - pressure and vacuum gauges - including high vacuum gauges - stroboscope and stop watch - fluid and gaseous flow meters - test lamps and electrical meters - leak detectors: <ul style="list-style-type: none"> - halide leak detector - electronic leak detector - soap test - litmus test - PH indicators - acid test kit - electric thermometers & thermocouples - dry & wet bulb thermometers 	<ul style="list-style-type: none"> - Read prints, diagrams and charts - Identify the various types of test instruments - Select the required accessories - Select the test instrument based upon: <ul style="list-style-type: none"> - its respective application to: - determine the moisture content - determine the salt content - measure air, liquid and refrigerant pressure, temperature and velocity - determine and measure rotation and speed - check continuity and current flow - check for refrigerant leaks - check PH - the chemistry of a refrigerant and its state as a liquid or gas - the unit of measurement based upon: <ul style="list-style-type: none"> - the British system - the Metric system - the instrument's limitations vis-à-vis: <ul style="list-style-type: none"> - range - sensitivity - precision 	<p>Select a test instrument based upon:</p> <ul style="list-style-type: none"> - its respective application - the refrigerant tested - the units of measurements - the instrument's limitations

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<p>OPERATE:</p> <ul style="list-style-type: none">- TEST INSTRUMENTSof the following types:- hydrometers and moisture indicators- salometers- pressure and vacuum gauges- including high vacuum gauges- stroboscope and stop watch- fluid and gaseous flow meters- test lamps and electrical meters- leak detection devices of the following types:- halide leak detector- electronic leak detector- soap test- litmus test- sulphur test- PH indicators- acid test kit- electric thermometers & thermocouples- dry and wet bulb thermometers	<ul style="list-style-type: none">- Read prints, diagrams and charts- Adjust and calibrate the test instrument- Select correct range and scale- Connect and operate the instrument; interpret the results by giving correct value and unit of measurement- Handle, maintain and store the instrument	<p>Operate test instruments to check, measure and test:</p> <ul style="list-style-type: none">- refrigerant lines- electrical circuits- liquid lines- the air distribution system	

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<p>SELECT:</p> <ul style="list-style-type: none"> - REFRIGERANTS <p>of the following types:</p> <ul style="list-style-type: none"> - halocarbons - ammonia 	<ul style="list-style-type: none"> - Read graphs, tables and charts - Determine the following characteristics of the refrigeration and air conditioning systems: <ul style="list-style-type: none"> - type of compressor - tonnage of the compressor - cooling method of the condenser - required evaporator operating temperature - Identify the specified types of refrigerants and their characteristic properties and determine the applications of each - Identify the colour and number coding used to distinguish the refrigerants - Select proper containers for the: <ul style="list-style-type: none"> - amount of refrigerant required - type of refrigerant - prevention of contamination - Determine methods of safe handling of the refrigerant - Identify the manufacturer's recommendations for the type of system to be used - Identify hazardous refrigerants no longer in use that may be found in older systems, such as methyl chloride 	<p>Refrigerants must be selected as to the:</p> <ul style="list-style-type: none"> - pressure and temperature relationship for liquefaction in the condenser - pressure required in the evaporator to achieve the evaporation temperature - cooling capacity of the evaporator - ratio of the gas volume to the liquid weight - ability to be easily detected for leakage for the type of system in which it is to be used - corrosive action it has on metals - optimum suitability, as prescribed by the manufacturer, for application to a specific refrigeration or air conditioning system 	

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<p>SELECT:</p> <ul style="list-style-type: none"> - REFRIGERANT OILS of the following types: <ul style="list-style-type: none"> - paraffin base - naphthene base 	<ul style="list-style-type: none"> - Read graphs, charts and tables - Determine the following characteristics of the refrigeration and air conditioning systems: <ul style="list-style-type: none"> - compressor temperature - type of compressor - evaporator temperature - type of refrigerant - Select additives to reduce foaming and the formation of sludge - Perform the dielectric test to check for moisture content - Select the properly sealed oil containers for the amount of oil to be used - Determine the methods of handling the oil safely 	<p>Refrigerant oils must be selected as to their:</p> <ul style="list-style-type: none"> - wax content - thermal stability - chemical stability - pour point - viscosity <p>For:</p> <ul style="list-style-type: none"> - the required temperature range of the system (evaporator and compressor) - compatibility with the refrigerant to be used <p>Refrigerant oils must not be contaminated and must be handled safely in sealed containers.</p>	

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<p>SELECT:</p> <ul style="list-style-type: none"> - BRINES <p>of the following types:</p> <ul style="list-style-type: none"> - calcium chloride - sodium chloride - magnesium chloride <p>NOTE:</p> <p>Brines are used for:</p> <ul style="list-style-type: none"> - open piping systems - closed piping systems 	<ul style="list-style-type: none"> - Read graphs, tables and charts - Determine, measure and test the following properties of brines: <ul style="list-style-type: none"> - specific gravity - viscosity - conductivity - specific heat - concentration - freezing point - boiling point - Mix brines - Select and add chemical additives to <ul style="list-style-type: none"> - prevent corrosion - control the density and alkalinity - maintain the concentration - Apply safety measures to handle brines 	<p>Select brines based upon:</p> <ul style="list-style-type: none"> - freezing point - application - cost - safety - thermal performance - suitability - codes and ordinances - eutectic point <p>Pump rating and motor horsepower should be based on the particular brine used and the actual operating temperature. All materials in the piping system must be compatible with the brine.</p>	

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INSTALL AND REPLACE: - PIPING - copper - brass - aluminum - steel - iron - plastic	<ul style="list-style-type: none"> - Read charts, drawings, piping diagrams, pressure graphs and tables for line velocities - Select the required piping for a specific application in order to ensure: <ul style="list-style-type: none"> - the required degree of temperature - correct wall thickness - resistance to corrosion - suitability for pressure or non-pressure applications - Select and operate the required tools in order to: <ul style="list-style-type: none"> - cut piping in such a manner to prevent chips from falling into the section that is to be used - bend piping without causing ruptures or flattening of the pipe - flare piping to form a leakproof joint between pipe and a fitting - effect swaging, threading, and glueing of piping - anneal and constrict piping for use during installation or when replacing piping in an existing facility - Select, install, or replace insulation and fittings for piping to ensure: <ul style="list-style-type: none"> - the correct fitting for a specific installation - proper soldered or brazed connections between the fitting and the piping employed in the system - Pressurize piping with an inert gas for brazing and leak tests 	<p>All piping utilized in air conditioning and refrigeration systems will be suitable to the design of the system, and allow for the velocities, variations in pressure, and protection for the compressor.</p> <p>Piping must be clean and dry inside, and be kept sealed at the ends in order to facilitate cleanliness during handling.</p> <p>Procedures employed for supports and hangers will meet the requirements of applicable codes and regulations.</p>	

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	<ul style="list-style-type: none">- Safely handle nitrogen and operate 2-stage regulators- Determine and implement the correct procedure to:<ul style="list-style-type: none">- install pipe hangers and supports- cut and thread rod hangers- install or replace hangers in steel, concrete or wood- based upon the following considerations:<ul style="list-style-type: none">- required frequency of support in order to keep piping straight and firm in position- elimination of chafing or galvanic action between hangers (clamps) and piping- Determine and apply the correct methods:<ul style="list-style-type: none">- to install or replace piping along walls or ceilings- to provide adequate protection for piping which is run through floors or walls- to arrange (run) tubing/piping horizontally and vertically with bends as close to perfect radius as possible- in order to install the suction lines so that piping will drain toward the compressor- to avoid positioning piping near sources of heat- to seal piping, during installation, immediately following flare or streamline connections- with coverings, which serve as protection and insulation, to place the covering on the piping prior to assembly- to run the piping in such a manner that the support will protect the tubing from accidents	<p>The installation or replacement of piping will include care to prevent damage or buckling of the material. In a non-code installation, where individual suction lines and liquid lines run into main lines, T-connections may be used. Valves, driers, or other heavy objects must not be supported by the piping or tubing.</p>	

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<p>INSTALL:</p> <ul style="list-style-type: none"> - rotary compressor assemblies of the following types: <ul style="list-style-type: none"> - open - hermetic <p>NOTE:</p> <p>Open compressors are of the following types:</p> <ul style="list-style-type: none"> - belt driven - direct drive <p>The cooling methods are:</p> <ul style="list-style-type: none"> - air - water - refrigerant <p>The compressor assembly includes:</p> <ul style="list-style-type: none"> - compressor - valves, seals and couplings - controls - electrical wiring - drive motor and assembly 	<ul style="list-style-type: none"> - Read prints, diagrams and schematics - Receive and uncrate a compressor assembly and check the shipment for shortage or damage - Select and operate the required tools - Perform the necessary electrical and mechanical tests, checks and measurements - Mount a rotary compressor assembly based upon: <ul style="list-style-type: none"> - space requirements and mounting methods - the compressor selection - the drive mechanism - an adequate supply of air or water - ventilation - accessibility - piping layout - installation codes - Connect electric motors based upon: <ul style="list-style-type: none"> - power, voltage and phase requirements - electrical codes - Make the pipe connections including couplings and fittings to the following lines: <ul style="list-style-type: none"> - refrigerant - water - oil <p>based upon:</p> <ul style="list-style-type: none"> - types and sizes of fittings - specified refrigerant - piping layout - installation codes 	<p>All rotary compressor assemblies will:</p> <ul style="list-style-type: none"> - be levelled and mounted firmly - have proper electrical and mechanical connections - maintain correct refrigerant pressures and temperature - have no leakage in refrigerant, oil or water lines - have correct shaft rotation and speed - have adequate cooling - operate with minimal noise and vibrations - be installed according to installation codes and manufacturer's instructions - have proper component alignment 	

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<p>INSTALL:</p> <ul style="list-style-type: none"> - RECIPROCATING COMPRESSOR ASSEMBLIES <p>of the following types:</p> <ul style="list-style-type: none"> - open - semi-hermetic - hermetic - two stage <p>NOTE:</p> <p>Open compressors are:</p> <ul style="list-style-type: none"> - belt driven - direct drive <p>The drive may be:</p> <ul style="list-style-type: none"> - an electric motor - a combustion engine - a steam turbine <p>The cooling methods are:</p> <ul style="list-style-type: none"> - air - water - refrigerant <p>Refrigerant used are:</p> <ul style="list-style-type: none"> - halocarbons - ammonia 	<ul style="list-style-type: none"> - Read prints, diagrams and schematics - Receive and uncrate a compressor assembly and check the shipment for shortage or damage - Select and operate the required tools - perform electrical and mechanical checks, tests and measurements - Mount: <ul style="list-style-type: none"> - a reciprocating compressor assembly - parallel compressors assemblies - based upon: <ul style="list-style-type: none"> - space requirements and mounting methods - the compressor selection - the drive mechanism - an adequate supply of air or water - ventilation - accessibility - piping layout - installation codes - Connect electric motors based upon: <ul style="list-style-type: none"> - power, voltage and phase requirements - electrical codes - Make the pipe connections including couplings and fittings to the following lines: <ul style="list-style-type: none"> - refrigerant - oil - water - steam - fuel - exhaust 	<p>All reciprocating compressor assemblies will:</p> <ul style="list-style-type: none"> - be levelled and mounted firmly - have proper component alignment - have proper electrical and mechanical connections - maintain correct refrigerant pressures and temperature - have no leakage in refrigerant, water or oil lines - have correct shaft rotation and speed - have adequate cooling - operate with minimal noise and vibrations - be installed according to installation codes and manufacturer's instructions <p>Tandem compressor assemblies will be installed based upon:</p> <ul style="list-style-type: none"> - equal suction and discharge pressure - even oil distribution 	

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<p>The compressor assembly includes:</p> <ul style="list-style-type: none"> - compressor - valves, seals and coupling - controls - electrical wiring - drive motor and assembly 	<p>based upon:</p> <ul style="list-style-type: none"> - types and sizes of fittings - specified refrigerant - piping layout - installation codes <p>- Mount and connect equalization lines for tandem compressor assemblies</p>	

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TERMINAL PERFORMANCE OBJECTIVES : To be able to...	ENABLING OBJECTIVES : Will be able to...	TERMINAL PERFORMANCE CRITERIA : Minimum acceptable standard...
<p>INSTALL:</p> <ul style="list-style-type: none"> - CENTRIFUGAL COMPRESSOR ASSEMBLIES - of the following types: <ul style="list-style-type: none"> - hermetic - open <p>NOTE:</p> <p>Open compressors are of the following types:</p> <ul style="list-style-type: none"> - belt driven - direct drive <p>The drive may be:</p> <ul style="list-style-type: none"> - an electric motor - a combustion engine - a steam turbine <p>The cooling methods are:</p> <ul style="list-style-type: none"> - air - water - refrigerant <p>Refrigerants used are:</p> <ul style="list-style-type: none"> - halocarbons - ammonia 	<ul style="list-style-type: none"> - Read prints, diagrams and schematics - Receive and uncrate a compressor assembly and check the shipment for shortage or damage - Select and operate the required tools - Perform electrical and mechanical checks, tests and measurements - Mount a centrifugal compressor assembly based upon: <ul style="list-style-type: none"> - space requirements and mounting methods - the compressor selection - the drive mechanism - an adequate supply of air or water - ventilation - accessibility - piping layout - installation codes - Connect electric motors based upon: <ul style="list-style-type: none"> - power, voltage and phase requirements - electrical codes - Make the pipe connections including coupling and fittings to the following lines: <ul style="list-style-type: none"> - refrigerant - oil - water - steam - fuel - exhaust 	<p>All centrifugal compressor assemblies will:</p> <ul style="list-style-type: none"> - be levelled and mounted firmly - have proper component alignment - have proper electrical and mechanical connections - maintain correct refrigerant pressures and temperature - have no leakage in refrigerant, water or oil lines - have correct shaft rotation and speed - have adequate cooling - operate with minimal noise and vibrations - be installed according to installation codes and manufacturer's instructions

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<p>The compressor assembly includes:</p> <ul style="list-style-type: none"> - compressor - valves, seals and couplings - controls - electrical wiring - drive motor and assembly 	<p>based upon:</p> <ul style="list-style-type: none"> - types and sizes of fittings - specified refrigerant - piping layout - installation codes 		

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<p>INSTALL:</p> <ul style="list-style-type: none"> - CONDENSER ASSEMBLIES of the following types: - air cooled - water cooled - evaporative <p>NOTE: The condenser assembly includes:</p> <ul style="list-style-type: none"> - coils - receivers - valves and couplings - fans - drive motor and controls - pipes and fittings 	<ul style="list-style-type: none"> - Read prints, diagrams and schematics - Receive and uncrate a condenser assembly and check the shipment for shortage or damage - Select and operate the required tools - Perform electrical and mechanical checks, tests and measurements - Mount: <ul style="list-style-type: none"> - packaged condenser assemblies - built-up condenser assemblies - multiple condenser assemblies - based upon: <ul style="list-style-type: none"> - space requirements and mounting methods - adequate air or water supply - the condenser selection - ventilation - drain facilities - accessibility - pipe layout - installation codes - Connect electric motors based upon: <ul style="list-style-type: none"> - power, voltage and phase requirements - electrical installation codes - Make the pipe connections including couplings and fittings to: <ul style="list-style-type: none"> - refrigerant lines - liquid lines - drain lines 	<p>All condenser assemblies will:</p> <ul style="list-style-type: none"> - be levelled and mounted firmly - have proper component alignment - have proper electrical and mechanical connections - maintain correct refrigerant and water flow and pressure - have no leakage in refrigerant or water lines - have connect fan rotation - operate with minimal noise and vibrations - be installed according to installation codes and manufacturer's instructions

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	<p>based upon:</p> <ul style="list-style-type: none"> - types and sizes of fittings - specific refrigerant - pipe layout - installation codes <p>- Mount and connect multiple condenser assemblies with:</p> <ul style="list-style-type: none"> - a compressor assembly - tandem compressor assemblies 	

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<p>INSTALL</p> <ul style="list-style-type: none"> - EVAPORATOR ASSEMBLIES of the following types: <ul style="list-style-type: none"> - air cooling - liquid cooling <p>NOTE:</p> <p>Air cooling coils are of the following types:</p> <ul style="list-style-type: none"> - forced convection - natural convection <p>Chillers are of the following types:</p> <ul style="list-style-type: none"> - water - brine - product 	<ul style="list-style-type: none"> - Read prints, diagrams and schematics - Receive and uncrate an evaporator assembly and check the shipment for shortage or damage - Select and operate the required tools - Perform electrical and mechanical checks, tests and measurements - Mount: <ul style="list-style-type: none"> - package evaporator assemblies - built-up evaporator assemblies - multiple evaporator assemblies - based upon: <ul style="list-style-type: none"> - space requirements and mounting methods - evaporator selection - specified air flow - piping layout - drain facilities - accessibility - installation codes 	<p>All evaporator assemblies will:</p> <ul style="list-style-type: none"> - be levelled and mounted firmly - have proper component alignment - have proper mechanical and electrical connections - maintain correct refrigerant flow and pressure - have no leakage in refrigerant or liquid lines - have correct fan rotation - maintain correct defrost cycle - operate with minimal noise and vibrations - be installed according to installation codes and manufacturer's instructions 	

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<p>The evaporator assembly includes the following components:</p> <ul style="list-style-type: none"> - coils - valves and couplings - fans - drive motor and controls - defrost apparatus 	<ul style="list-style-type: none"> - Connect electric motors and defrosters based upon: <ul style="list-style-type: none"> - power, voltage and phase requirements - electrical installation codes - Make the necessary pipe connections including couplings and fittings to: <ul style="list-style-type: none"> - refrigerant lines - liquid lines - drain lines - defrost lines <p>based upon:</p> <ul style="list-style-type: none"> - types and sizes of fittings - specified primary and secondary refrigerant - specified liquid - pipe layout - installation codes 		

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<p>INSTALL:</p> <ul style="list-style-type: none"> - DEFROST SYSTEMS <p>of the following types:</p> <ul style="list-style-type: none"> - hot gas - water spray - electric heaters - brine spray - conventional system shutdown <p>NOTE:</p> <p>Controls that regulate coil frost accumulation are:</p> <ul style="list-style-type: none"> - a timer switch - a pressure switch - a defrost control 	<ul style="list-style-type: none"> - Read prints, diagrams and schematics - Receive and uncrate a defrost unit and check it for shortage or damage - Select and operate the required tools - Perform the necessary electrical and mechanical checks, tests and measurements - Mount defrost units based upon: <ul style="list-style-type: none"> - space requirements and mounting methods - evaporator design - accessibility - drain facilities - piping layout - installation codes - Connect electric heaters and controls based upon: <ul style="list-style-type: none"> - power and voltage requirements - electrical code - Make the pipe connections including couplings and fittings to the following lines: <ul style="list-style-type: none"> - refrigerant - drain - brine - water <p>based upon:</p> <ul style="list-style-type: none"> - types and sizes of fittings: 	<p>All defrost units will:</p> <ul style="list-style-type: none"> - be mounted firmly - have no leakage in refrigerant or water lines - maintain correct defrost cycle - be installed according to installation codes and manufacturer's instructions

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	<ul style="list-style-type: none"> - brazed connections - flared connections - quick connect and disconnect couplings - specified refrigerant - piping layout - installation codes - apply safety measures by: <ul style="list-style-type: none"> - wearing protective clothing and using protective equipment - ensuring sufficient ventilation - the safe handling and storage of refrigerants and oils - the safe use of lifting and hoisting apparatus, power and manual tools, welding equipment - following safety rules and good housekeeping policies 		

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INSTALL: - CONTROL VALVES of the following types: - electric - automatic - manual - pneumatic - electronic	<ul style="list-style-type: none"> - Read prints, diagrams and schematics - Receive the shipment and check it for shortage or damage - Select and operate: <ul style="list-style-type: none"> - the required tools - the measuring instruments - Mount control valves based upon: <ul style="list-style-type: none"> - mounting methods - the control valve design - accessibility - the piping layout - the wiring layout - installation codes - Wire the control valve based upon: <ul style="list-style-type: none"> - the applied voltage and current - the electrical codes - Make the pipe connections, including couplings and fittings, to the following lines: <ul style="list-style-type: none"> - refrigerant - oil - water - based upon: <ul style="list-style-type: none"> - types and sizes of fittings: <ul style="list-style-type: none"> - brazed connections - flared connections - quick connect and disconnect couplings - specified refrigerant - piping layout - installation codes 	All control valves will: <ul style="list-style-type: none"> - be mounted firmly - be aligned and adjusted - have proper electrical and mechanical connections - have no refrigerant, oil or water leakage - be installed according to installation codes and manufacturer's instructions 	

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	<ul style="list-style-type: none"> - Test and adjust the control valve - Apply safety measures: <ul style="list-style-type: none"> - by following safety rules and good housekeeping policies 		

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<p>INSTALL:</p> <ul style="list-style-type: none"> - Metering Devices of the following types: - capillary tube - automatic expansion valve - thermostatic expansion valve - hand operated expansion valve - low-pressure float valve - high-pressure float valve 	<ul style="list-style-type: none"> - read prints, diagrams and charts - identify and check the metering device shipment for shortage or damage - select and operate: <ul style="list-style-type: none"> - the required tools - the measuring instruments - select the correct metering device for a: <ul style="list-style-type: none"> - flooded system - dry system - mount and connect metering device based upon: <ul style="list-style-type: none"> - the mounting methods - the metering device selection - the piping layout - the types and sizes of the fittings: <ul style="list-style-type: none"> - flared connections - brazed connections - quick connect and disconnect couplings - specified refrigerant - installation codes - install and connect an oil return mechanism for float valves - test and adjust metering device: - apply safety measures: <ul style="list-style-type: none"> - by wearing protective clothing - by using protective equipment - by following safety rules and good housekeeping policies 	<p>All metering devices will:</p> <ul style="list-style-type: none"> - be mounted firmly, and levelled if required - have proper mechanical connections - have no leakage in refrigerant lines - regulate the amount of liquid refrigerant flow in the evaporator - be installed according to installation codes and manufacturer's instructions

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INSTALL: - SYSTEM CONTROLS of the following types: - thermostats - pressurestats - humidistats	<ul style="list-style-type: none"> - Read prints, diagrams and schematics - Receive the shipment and check it for shortage or damage - Select and operate required tools - Select and operate the measuring instruments - Mount the system control based upon: <ul style="list-style-type: none"> - the mounting methods - the control design - the air distribution - the wiring layout - accessibility - the installation codes - Wire the control based upon: <ul style="list-style-type: none"> - the applied voltage and current - the electrical codes - Test and adjust the system control - Apply safety measures: <ul style="list-style-type: none"> - by following safety rules and good housekeeping policies 	All system controls will: <ul style="list-style-type: none"> - be mounted firmly - be aligned and adjusted - have proper electrical connections - be installed according to installation codes and manufacturer's instructions 	

SPECIFIC PERFORMANCE OBJECTIVES AND CRITERIA FOR :

REFRIGERATION AND AIR CONDITIONING MECHANIC

CCDO No.

TERMINAL PERFORMANCE OBJECTIVES : To be able to...	ENABLING OBJECTIVES : Will be able to...	TERMINAL PERFORMANCE CRITERIA : Minimum acceptable standard...
<p>INSTALL:</p> <ul style="list-style-type: none"> - AIR HANDLING AND DISTRIBUTION EQUIPMENT of the following types: <ul style="list-style-type: none"> - single zone - multi-zone - air induction - water induction - conventional <p>NOTE:</p> <p>Air Handling and Distribution Units include:</p> <ul style="list-style-type: none"> - blower fan assembly - duct system - registers, grills, dampers and diffusers - humidifiers and dehumidifiers assemblies - air cleaning assemblies - exhaust hoods - mixing chambers - heating and cooling coils - controls 	<ul style="list-style-type: none"> - Read prints, graphs, charts, schematics and tables - Receive and uncrate the assemblies and components and check each shipment for shortage or damage - Rig and hoist the shipment - Select and operate: <ul style="list-style-type: none"> - the required tools - the measuring instruments - Mount components and assemblies based upon: <ul style="list-style-type: none"> - space requirements and mounting methods - an adequate supply of air or water - the specified layout - accessibility - duct size and layout - piping layout - drain facilities - installation codes - Connect the electrical components based upon: <ul style="list-style-type: none"> - power and voltage requirements - electrical codes - Measure air flow - Cut sheet metal - Connect pre-fabricated sheet metal duct units 	<p>All air handling and distribution equipment will:</p> <ul style="list-style-type: none"> - be mounted firmly - have proper electrical and mechanical connections - have no leakage of air or water - operate with minimal noise and vibrations - be installed according to installation codes and manufacturers instructions <p>Registers, diffusers, grills and dampers will produce:</p> <ul style="list-style-type: none"> - the required fresh and recirculated air mixture - the required air flow, direction and balance <p>The conditioned air will be clean. The desired temperature and humidity will be maintained. No drafts are permitted.</p>

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	<ul style="list-style-type: none"> - Make all pipe connections based upon: <ul style="list-style-type: none"> - the types and sizes of couplings and fittings: <ul style="list-style-type: none"> - flared connections - brazed connections - quick connect and disconnect the couplings - piping layout - installation codes - Start the system - Adjust registers, grills, dampers and diffusers - Adjust mechanical and electrical controls - Apply safety measures by following safety rules and good housekeeping rules 		

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<p>INSTALL:</p> <ul style="list-style-type: none"> - HUMIDIFIER ASSEMBLIES <p>of the following types:</p> <ul style="list-style-type: none"> - spray-type air washers - pan evaporative - electrically operated - air operated - rotating drum <p>NOTE:</p> <p>The humidifier assembly includes:</p> <ul style="list-style-type: none"> - water or steam holding tank - valves and couplings - piping and tubing - fan - drive motor and controls - temperature and controls - humidity controls - pump assembly 	<ul style="list-style-type: none"> - Read prints, diagrams and schematics - Receive and uncrate a specified assembly and check the shipment for shortage or damage - Select and operate the required tools - Perform the necessary electrical and mechanical checks, tests and measurements - Mount humidifier assemblies based upon: <ul style="list-style-type: none"> - space requirements and mounting methods - the humidifier selection - specified air flow - adequate water supply - drain facilities - accessibility - duct layout - piping layout - installation codes - Connect electric motors and controls based upon: <ul style="list-style-type: none"> - power, voltage and phase requirements - electrical codes - Make the pipe connections including couplings and fittings to the following lines: <ul style="list-style-type: none"> - circulating water lines - make-up water - drain - based upon: <ul style="list-style-type: none"> - types and sizes of fittings - chemical additives - piping layout - installation codes 	<p>All humidifier assemblies will:</p> <ul style="list-style-type: none"> - be levelled and mounted firmly - have proper component alignment - have proper electrical and mechanical connections - maintain correct water flow and level - have no leakage in water lines - have correct shaft rotation and speed - have correct fan rotation - be free of any corrosion, scale or algae build-up - operate with minimal noise and vibration - be installed according to installation codes and manufacturer's instructions

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	<ul style="list-style-type: none"> - Select and add chemical additives to prevent: <ul style="list-style-type: none"> - corrosion - algae - scale build-up 		

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<p>INSTALL:</p> <ul style="list-style-type: none"> - AIR CLEANER ASSEMBLIES <p>of the following types:</p> <ul style="list-style-type: none"> - electronic - air washers - filters, dry and viscous <p>NOTE:</p> <p>Filters are of the following types:</p> <ul style="list-style-type: none"> - replaceable - manually-cleaned - automatically-cleaned <p>Electronic filters are of the following types:</p> <ul style="list-style-type: none"> - ionizing - charged media <p>The pump units are of the following types:</p> <ul style="list-style-type: none"> - open - hermetic <p>Open pump assemblies are:</p> <ul style="list-style-type: none"> - belt driven - direct drive 	<ul style="list-style-type: none"> - Read prints, diagrams and schematics - Receive and uncrate a specified assembly and check the shipment for shortage or damage - Select and operate the required tools - Perform the necessary electrical and mechanical checks, tests and measurements - Mount air cleaner assemblies based upon: <ul style="list-style-type: none"> - space requirements of mounting methods - the selection of the assembly - specified air flow - adequate water supply - drain facilities - duct layout - piping layout - environmental conditions - installation codes - Connect electric motors, power pack and controls based upon: <ul style="list-style-type: none"> - power, voltage and phase requirements - electrical codes - Make the pipe connections including couplings and fittings to: <ul style="list-style-type: none"> - water or steam lines - drain lines <p>based upon the following considerations:</p> <ul style="list-style-type: none"> - types and sizes of fitting - piping layout - installation codes 	<p>All air cleaner assemblies will:</p> <ul style="list-style-type: none"> - be levelled and mounted firmly - have proper component alignment - have proper electrical and mechanical connections - maintain correct water flow - have correct shaft rotation and speed - handle the specified quantity of air - remove the amount of dust required - be accessible for removal and cleaning - have no air leakage - operate with minimal noise and vibrations - be installed according to installation codes and manufacturer's instructions

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<p>The air cleaner assembly includes:</p> <ul style="list-style-type: none"> - filter - recirculating pump - power pack - wiring and controls - washer nozzle and holding tank 			

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<p>INSTALL:</p> <ul style="list-style-type: none"> - COOLING TOWER ASSEMBLIES of the following types: <ul style="list-style-type: none"> - natural draft - induced draft - forced draft <p>NOTE:</p> <p>The pump unit can be:</p> <ul style="list-style-type: none"> - open - hermetic <p>Open pump units are of the following types:</p> <ul style="list-style-type: none"> - direct drive - belt driven <p>The assembly includes:</p> <ul style="list-style-type: none"> - pump - piping and valves - basin - fan and drive motor - controls - spray nozzles and deck 	<ul style="list-style-type: none"> - Read prints, diagrams and schematics - Receive and uncrate a specified assembly and check the shipment for shortage or damage - Select and operate the required tools - Perform the necessary electrical and mechanical checks, tests and measurements - Mount cooling tower assemblies based upon: <ul style="list-style-type: none"> - space requirements and mounting methods - the cooling tower selection - the specified air flow - an adequate water supply - suitable ventilation - accessibility - drain facilities - piping layout - installation codes - Connect electric motors based upon: <ul style="list-style-type: none"> - power, voltage and phase requirements - electrical code - Make the pipe connections including couplings and fittings to the following lines: <ul style="list-style-type: none"> - circulating water - make-up water - drain - based upon: <ul style="list-style-type: none"> - types and sizes of fittings - chemical additives - piping layout - installation codes 	<p>All cooling tower assemblies will:</p> <ul style="list-style-type: none"> - be levelled and mounted firmly - have proper component alignment - have proper electrical and mechanical connections - maintain correct water flow, temperature and level - have no leakage in water line - have correct shaft rotation and speed - have correct fan rotation - be free of any corrosion, scale, algae or ice build-up - operate with minimal noise and vibrations - be installed according to installation codes and manufacturer's instructions

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	<ul style="list-style-type: none">- Select and add chemical additives to prevent:<ul style="list-style-type: none">- corrosion- scale build-up- algae- ice build-up			

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<p>INSTALL:</p> <ul style="list-style-type: none"> - ICE MAKER ASSEMBLIES of the following types: <ul style="list-style-type: none"> - ice cube makers - ice flake makers <p>NOTE: Removal of ice is accomplished by:</p> <ul style="list-style-type: none"> - electrical heating elements - hot water - hot gas defrosting - mechanical ice removal <p>The ice maker assembly includes:</p> <ul style="list-style-type: none"> - ice maker evaporator - piping and tubing - valves and couplings - defrosting apparatus - scoring, crushing or curling equipment - storage bins - electrical wiring and controls 	<ul style="list-style-type: none"> - Read prints, diagrams and schematics - Receive and uncrate a specified assembly and check the shipment for shortage or damage - Select and operate the required tools - Perform the necessary electrical and mechanical checks, tests and measurements - Mount ice maker assemblies based upon: <ul style="list-style-type: none"> - space requirements and mounting methods - the selection of the assembly <ul style="list-style-type: none"> - water supply - drain facilities - defrost apparatus - piping layout - accessibility - installation codes - Connect electric heaters based upon: <ul style="list-style-type: none"> - power and voltage requirements - electrical codes - Make the pipe connections including couplings and fitting to the following lines: <ul style="list-style-type: none"> - water - refrigerant - defrost - drain <p>based upon:</p> <ul style="list-style-type: none"> - types and sizes of fitting - specified refrigerant - piping layout - installation codes 	<p>All ice maker assemblies will:</p> <ul style="list-style-type: none"> - be levelled and mounted firmly - have proper electrical and mechanical connections - maintain correct water flow - maintain correct refrigerant flow and pressure - have no leakage in refrigerant and water lines - maintain correct defrost cycle - produce the specified quantity of ice - operate with minimal noise and vibrations - be installed according to installation codes and manufacturer's instructions

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<p>INSTALL:</p> <ul style="list-style-type: none"> - CIRCULATING PUMP ASSEMBLIES of the following types: - centrifugal - positive displacement <p>NOTE:</p> <p>Pump assemblies are:</p> <ul style="list-style-type: none"> - sealed - open: <ul style="list-style-type: none"> - direct drive - belt driven <p>THE DRIVE MAY BE:</p> <ul style="list-style-type: none"> - an electric motor - a combustion engine - a steam turbine <p>THE ABOVE TYPES INCLUDE THE FOLLOWING COMPONENTS:</p> <ul style="list-style-type: none"> - the pump assembly - drive mechanism and assembly - wiring and controls - valves, seals and couplings 	<ul style="list-style-type: none"> - Read prints, diagrams and schematics - Receive and uncrate a circulating pump assembly and check the shipment for shortage or damage - Perform the necessary electrical and mechanical checks, tests and measurements - Mount circulating pump assemblies based upon: <ul style="list-style-type: none"> - space requirements and mounting methods - the pump selection - the drive mechanism - an adequate supply of water - accessibility - piping layout - installation codes - Connect electric motors based upon: <ul style="list-style-type: none"> - power, voltage and phase requirements - electrical codes - Make the pipe connections including couplings and fittings to the following lines: <ul style="list-style-type: none"> - brine - water - refrigerant <p>based upon:</p> <ul style="list-style-type: none"> - types and sizes of fittings: - flared connections - brazed connections - quick connect and disconnect couplings - specified secondary refrigerant - piping layout - installation codes 	<p>All pump assemblies will:</p> <ul style="list-style-type: none"> - be levelled and mounted firmly - have proper component alignment - have proper electrical and mechanical connections - maintain correct liquid flow and pressure - have no leakage in liquid lines - operate with minimal noise and vibrations - be installed according to installation codes and manufacturer's instructions - have correct shaft rotation and speed

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	<ul style="list-style-type: none"> - Apply safety measures: <ul style="list-style-type: none"> - by wearing protective clothing - by using protective equipment - to handle secondary refrigerant - to use lifting and hoisting equipment, power and manual tools, and welding equipment - by following safety rules and good housekeeping policies 			

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<p>INSTALL:</p> <ul style="list-style-type: none"> - HEAT PUMP SYSTEMS <p>of the following types:</p> <ul style="list-style-type: none"> - air to air - water to air <p>The heat pump system includes:</p> <ul style="list-style-type: none"> - compressor assembly - outdoor coil assembly - indoor coil assembly - pipes and tubing - valves and couplings - wiring and controls - indoor fan assembly - electrical resistance heaters 	<ul style="list-style-type: none"> - Read prints, diagrams and schematics - Receive and uncrate a heat pump system and check the shipment for shortage or damage - Select and operate the required tools - Perform the necessary electrical and mechanical checks, tests and measurements - Mount packaged and split systems based upon: <ul style="list-style-type: none"> - space requirements and mounting methods - an adequate supply of air or water - the specified air flow - ventilation - accessibility - drain facilities - duct layout - piping layout - installation codes - Connect electric motors, heating coils and controls based upon: <ul style="list-style-type: none"> - power, voltage and phase requirements - electrical codes - Make the pipe connections including couplings and fittings to the following lines: <ul style="list-style-type: none"> - water - refrigerant - drain - defrost - based upon: <ul style="list-style-type: none"> - types and sizes of fittings - flared connections - brazed connections 	<p>All heat pump systems will:</p> <ul style="list-style-type: none"> - be levelled and mounted firmly - have proper electrical and mechanical connections - have no leakage in refrigerant or water lines - maintain correct cycle for heating, cooling and defrosting - operate with refrigeration cycle pressures and temperatures that are in accordance with the manufacturer's specifications - operate with minimal noise and vibrations - be installed according to installation codes and manufacturer's instructions

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	<ul style="list-style-type: none"> - quick connect and disconnect couplings - specified refrigerant - piping layout - installation codes - Layout, install and connect the following lines: <ul style="list-style-type: none"> - suction - liquid - water - defrost - drain - Purge, charge and test the system - Start the dry or flooded system - Apply safety measures: <ul style="list-style-type: none"> - by wearing protective clothing - by using protective equipment - by ensuring sufficient ventilation - to handle and store refrigerant and oils - to use lifting and hoisting equipment, power and manual tools, welding equipment - by following safety rules and good housekeeping policies 		

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<p>INSTALL:</p> <ul style="list-style-type: none"> - CENTRAL RESIDENTIAL AIR CONDITIONING SYSTEMS <p>of the following types:</p> <ul style="list-style-type: none"> - packaged - split systems - combination <p>NOTE: Combination systems have independent heating and cooling operations</p>	<ul style="list-style-type: none"> - Read prints, diagrams and schematics - Receive and uncrate a system and check the shipment for shortage or damage - Select and operate the required tools - Perform the necessary electrical and mechanical checks, tests and measurements - Mount air conditioning systems based upon: <ul style="list-style-type: none"> - space requirements and mounting methods - an adequate supply of air or water - the specified air flow - sufficient ventilation - accessibility - drain facilities - duct layout - piping layout - installation codes - Connect electric motors and heating coils based upon: <ul style="list-style-type: none"> - power, voltage and phase requirements - electrical codes - Make the pipe connections including coupling and fittings to the following lines: <ul style="list-style-type: none"> - water - refrigerant - drain - defrost <p>based upon:</p> <ul style="list-style-type: none"> - types and sizes of fittings: - flared connections 	<p>All air conditioners will:</p> <ul style="list-style-type: none"> - be levelled and mounted firmly - have proper electrical and mechanical connections - have no leakage in refrigerant or water lines - transfer the required quantity of heat during the cooling cycle or heating cycle - operate with minimal noise and vibrations - be installed according to the installation codes and manufacturer's instructions

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	<ul style="list-style-type: none"> - brazed connections - quick connect and disconnect couplings - the specified refrigerant - the piping layout - the installation codes - Layout, install and connect the following lines: <ul style="list-style-type: none"> - suction - liquid - water - defrost - drain - Purge, charge and test the system - Start the dry or flooded system - Apply safety measures: <ul style="list-style-type: none"> - by wearing protective clothing - by using protective equipment - by ensuring sufficient ventilation - to handle and store refrigerants and oils - to use hoisting and lifting equipment, power and manual tools, welding equipment - by following safety rules and good housekeeping policies 		

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INSTALL: - PACKAGED SYSTEMS of the following types: - air conditioning systems - refrigerating systems	<ul style="list-style-type: none">- Read prints, diagrams and schematics- Receive and uncrate a packaged system and check the shipment for shortage or damage- Rig and hoist the packaged system- Select and operated:<ul style="list-style-type: none">- the required tools- the measuring instruments- Mount a packaged system based upon:<ul style="list-style-type: none">- space requirements and mounting methods- an adequate supply of air and water- the specified air flow- sufficient ventilation- accessibility- drain facilities- duct layout- piping layout- installation codes- Connect electric motors and heating coils based upon:<ul style="list-style-type: none">- power voltage and phase requirements- electrical codes- Wire the controls:<ul style="list-style-type: none">- the applied voltage and current- the electrical codes- Layout, install and connect the following lines:<ul style="list-style-type: none">- water- secondary refrigerant- drain	<p>All packaged systems will:</p> <ul style="list-style-type: none">- be levelled and mounted firmly- have proper electrical and mechanical connections- have no leakage in refrigerant, liquid or water lines- transfer the required quantity of heat during heating or cooling cycle- maintain correct defrost cycle- operate with minimal noise and vibrations- maintain correct refrigerant pressures and temperatures- be installed according to the installation codes and the manufacturer's specifications		

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	<ul style="list-style-type: none"> - Make the pipe connections including couplings and fittings based upon: <ul style="list-style-type: none"> - types and sizes of fittings - flared connections - brazed connections - quick connect and disconnect couplings - the secondary refrigerant - the piping layout - the installation codes - Check, test, adjust and start the system - Apply safety measures: <ul style="list-style-type: none"> - by wearing protective clothing - by using protective equipment - to use hoisting and lifting equipment, power and manual tools, and welding equipment - by following safety rules and good housekeeping policies 		

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<p>INSTALL:</p> <ul style="list-style-type: none"> - ABSORPTION SYSTEMS <p>of the following types:</p> <ul style="list-style-type: none"> - Industrial - Commercial <p>NOTE:</p> <p>The above systems include the following components:</p> <ul style="list-style-type: none"> - generator - separator - heat exchanger - absorber - analyzer - rectifier - condenser - evaporator - volume and safety controls - defroster - valves, piping and tubing - pumps 	<ul style="list-style-type: none"> - Read prints, diagrams, schematics and tables - Read installation specifications and manufacturer's recommendations - Identify the principal parts, principles of operation and parameters of performance - Rig loads and signal - Select necessary fasteners and use or operate necessary fastening devices - Install the specified components - Select, use or operate necessary measuring and alignment instruments - Apply safety measures: <ul style="list-style-type: none"> - by wearing protective clothing - by using protective equipment - to handle and store refrigerants and oils - to use hoisting and lifting equipment, power and manual tools and welding equipment - by following safety rules and good housekeeping policies 	<p>The absorption system must be installed in a safe and efficient manner to comply with the manufacturer's specifications and installation drawings.</p> <p>Components may be installed individually or as a packaged unit.</p> <p>Upon completion the absorption system must operate to the specified parameters at full load. No leaks permissible.</p> <p>Good safety practice must be adhered to for each application.</p>		

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INSTALL AND REPLACE: - REFRIGERATION ACCESSORIES of the following types: - vibration eliminators - discharge mufflers - crankcase heaters - receivers - heat exchangers - suction line accumulators - suction line filters - oil separators - dehydrators (driers) - strainers - sight glasses	<ul style="list-style-type: none"> - Read prints, diagrams and schematics - Evacuate and charge the system - Start and shut-down the system - Identify and check a refrigeration accessory shipment for shortage or damage - Select and operate the required tools to: <ul style="list-style-type: none"> - evacuate and charge the system - remove and install the accessory - Select and operate the instruments for: <ul style="list-style-type: none"> - temperature measurements - pressure measurements - Select the correct replacement - Mount and connect the refrigeration accessory based upon: <ul style="list-style-type: none"> - the mounting method - the allocated space - the accessory selection - the piping layout - the types and sizes of fittings: <ul style="list-style-type: none"> - flared connections - brazed connections - quick connect and disconnect couplings - the specified refrigerant - installation codes - Connect the crankcase heater based upon: <ul style="list-style-type: none"> - power and voltage requirements - electrical codes 	All accessories will: <ul style="list-style-type: none"> - be levelled and mounted firmly - have proper mechanical connections - have no leakage in refrigerant lines - be installed according to installation codes and manufacturer's instructions

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	<ul style="list-style-type: none"> - Apply safety measures: <ul style="list-style-type: none"> - by wearing protective clothing - by using protective equipment - by following safety rules and good housekeeping policies 			

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<p>MAINTAIN:</p> <ul style="list-style-type: none"> - REFRIGERATION SYSTEMS - AIR CONDITIONING SYSTEMS <p>of the following types:</p> <ul style="list-style-type: none"> - ammonia - halocarbons - two-stage - absorption - reverse cycle - multi-zone - air cooling - water cooling <p>NOTE:</p> <p>The above systems include:</p> <ul style="list-style-type: none"> - commercial - industrial - residential - transport - marine - special design 	<ul style="list-style-type: none"> - Read prints, schematics, charts and tables - Identify all the system components and determine the fundamentals of operation of each - Apply methods of system troubleshooting when a malfunction is present - Formulate and apply methods of overhauling systems for maintenance purposes, including: <ul style="list-style-type: none"> - checking and replacing filters - adjusting belts and pulleys - checking system controls and control valves - tightening contacts, relays and electrical controls - checking the condition and the level of float valves - replacing oil, driers - testing for leaks - drain, flush and clean water hoses, tubes and jackets - measure gas and liquid pressures, temperatures - lubricate all areas necessary - Charge, purge and evacuate systems - Operate the tools and measuring instruments necessary for the overhaul 	<p>System malfunctions must be recognized. Maintenance tasks will be performed safely with minimal disruption to the system. The complete system must be checked to ensure:</p> <ul style="list-style-type: none"> - clean tubing, hoses and water jacket - proper assembly operation - no impurities in the refrigerant and the oil - safe electrical connections and controls - proper operation of system controls - sufficient lubrication of moving parts - clean filters

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<p>SELECT:</p> <ul style="list-style-type: none"> - VACUUM PUMP ASSEMBLIES <p>NOTE: The above assemblies include the following components:</p> <ul style="list-style-type: none"> - hoses and couplings - valves - mountings - pump and motor - controls 	<ul style="list-style-type: none"> - Identify the types, sizes and applications of vacuum pumps - Identify from the manufacturer's specifications the: <ul style="list-style-type: none"> - type of drive: <ul style="list-style-type: none"> - belt - direct - capacity - voltage and power rating - pressure tolerance rating - horsepower - Identify the types of mountings and fasteners and their applications - Identify the components and determine the fundamentals of operation - Determine the connecting hoses based upon the valves, couplings and the length required 	<p>Vacuum pumps must be correctly selected as to their:</p> <ul style="list-style-type: none"> - type - size - capacity - voltage and power rating - pressure tolerance rating <p>For:</p> <ul style="list-style-type: none"> - the substance being evacuated: - liquid refrigerant - vapour - moisture and air - amount of material being evacuated and the rate of evacuation - the power supply - the required pressure and tolerance levels

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TERMINAL PERFORMANCE OBJECTIVES : To be able to...	ENABLING OBJECTIVES : Will be able to...	TERMINAL PERFORMANCE CRITERIA : Minimum acceptable standard...
<p>CONNECT AND OPERATE:</p> <ul style="list-style-type: none"> - THE GAUGE MANIFOLD <p>NOTE: The gauge manifold includes the following components:</p> <ul style="list-style-type: none"> - hoses - couplings - valves - gauges and gauge openings 	<ul style="list-style-type: none"> - Read diagrams, charts and tables - Operate the correct tools and equipment for: <ul style="list-style-type: none"> - mounting the manifold securely - connecting hoses, tubing and couplings - cleaning the gauges and the valves - repairing leaks - Select the correct size of hoses and couplings and determine the location in the system to connect them - Identify the components and determine the fundamentals of operation of each - Detect, isolate and repair leakage in the components - Determine the correct methods to operate the gauge manifold according to the function to be performed, such as: <ul style="list-style-type: none"> - reading pressures - charging (oil and refrigerant) - purging - testing for leaks - Disconnect and remove the gauge manifold such that: <ul style="list-style-type: none"> - no air is admitted to the system - no refrigerant or oil is lost 	<p>The gauge manifold will be connected safely and securely to prevent leakage in the connections.</p> <p>The gauge manifold will be operated safely to perform functions such as:</p> <ul style="list-style-type: none"> - taking pressure readings - checking for leaks in the system - charging and evacuating - adding oil - adding liquid driers - by-passing the compressor - unloading the gauge lines of high pressure liquid and vapor <p>No leakage is permitted</p> <p>Air must not be admitted and no refrigerant or oil lost after the manifold is disconnected.</p>

SPECIFIC PERFORMANCE OBJECTIVES AND CRITERIA FOR : REFRIGERATION AND AIR CONDITIONING MECHANIC CCDO No.		
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EVACUATE REFRIGERANT: - REFRIGERATION SYSTEMS - AIR CONDITIONING SYSTEMS	<ul style="list-style-type: none"> - Determine if a system has been over-charged and whether it is economical to salvage the refrigerant for re-use - Obtain a sufficient number of clean, dry, empty refrigerant containers and an accurate scale for weighing the refrigerant to be removed from the system - Remove refrigerant safely from a system by employing the optimum method, such as: <ul style="list-style-type: none"> - venting to the atmosphere, (outdoors if possible), as a vapor - utilizing the system compressor - using a transfer condensing unit - transferring refrigerant to a storage container by migration - break vacuum with nitrogen - Apply the required methods during evacuation in order to: <ul style="list-style-type: none"> - prevent a freeze up when removing refrigerant - prevent the refrigerant boiling-off at its saturated temperature - avoid spraying oil over the area adjoining the escaping refrigerant - ensure that care will be taken not to overfill refrigerant cylinders beyond their stated weight capacity - prevent close-off of the discharge valve to the condensor when utilizing the systems compressor 	<p>All evacuations of refrigerant will be accomplished by an economical and safe method.</p> <p>With systems containing less than ten pounds of refrigerant, care should be exercised to consider the economic advantage of venting the charge in lieu of salvaging the refrigerant.</p>

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PURGE: - REFRIGERATION SYSTEMS - AIR CONDITIONING SYSTEMS	<ul style="list-style-type: none"> - Determine the area to be purged: <ul style="list-style-type: none"> - liquid line - suction line - evaporation coil - Operate the correct tools and equipment to: <ul style="list-style-type: none"> - connect and disconnect the refrigerant lines - cap the lines - open and close the service valves - Operate leak detectors - Apply the most suitable method to purge systems by: <ul style="list-style-type: none"> - utilizing the compressor - operating a purge pump - Operate pressure gages - Charge the system 	All purging operations will: <ul style="list-style-type: none"> - be done safely - ensure no leakage - eliminate the non-condensables from the system - result in the correct refrigerant pressure

SPECIFIC PERFORMANCE OBJECTIVES AND CRITERIA FOR :		REFRIGERATION AND AIR CONDITIONING SYSTEMS		C C D O No.	
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CHARGE: - REFRIGERATION SYSTEMS - AIR CONDITIONING SYSTEMS of the following types: - halocarbons - ammonia	<ul style="list-style-type: none">- Determine and apply, for each system, the correct method for liquid or vapor charging utilizing an efficient and safe procedure- Determine the correct charging apparatus and type of refrigerant in order to:<ul style="list-style-type: none">- ensure that the service cylinder is filled to a safe level with the refrigerant required by the system- determine the weight of the refrigerant required by the proper use of weigh scales- make a record of the weight charged into the system- ensure that the system pumpdown capacity is not exceeded- charge factory assembled packaged units using welded compressors- accomplish vapor charging by means of a gauge manifold into the compressor suction service-valve-port- install a piercing-valve, or fitting, in the suction line if vapor charging is to be implemented- Determine and charge the required amount of refrigerant by the following methods:<ul style="list-style-type: none">- weighing the charge- using a sight glass- using a liquid level indicator- checking liquid subcooling- charging by superheat- charging by manufacturer's charging charts	All specified operations must ensure that the refrigeration or air conditioning system is not under-charged or over-charged, and all operations will obviate the danger of damage to the compressor valves because liquid has been charged (erroneously) into the compressor suction, or discharge service valve ports.			

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<p>TROUBLESHOOT SYSTEM MALFUNCTIONS</p> <p>Refrigeration Systems including:</p> <ul style="list-style-type: none"> - Industrial - Commercial - Recreational - Transport - Marine - Special Design <p>Air Conditioning Systems including:</p> <ul style="list-style-type: none"> - Commercial/Industrial - Residential - Institutional - Special Design 	<ul style="list-style-type: none"> - Apply systematic diagnostic and troubleshooting techniques to common system malfunctions - Recognize normal and abnormal operation of typical refrigeration and air conditioning systems such as: <ul style="list-style-type: none"> - ammonia and halocarbons - two-stage - cascade - multiplexed - absorption - reverse cycle - multi-zone - air heating and cooling - water heating and cooling - Apply the fundamentals of design of: <ul style="list-style-type: none"> - refrigeration assemblies (low, medium and high temperature) - heating assemblies (wet and dry) - humidifying and de-humidifying equipment - air cleaning and filtering units - refrigerant piping systems - air handling and distribution systems - water distribution systems - Select and measure the required refrigeration temperature - pressure check points - Understand the operation of typical control systems and know the function of each control device (manual and automatic): <ul style="list-style-type: none"> - electric, pneumatic and electronic - capacity controls (two position and modulating) 	<p>The most common system malfunctions must be identified accurately as to source and affected equipment assemblies. Refrigeration system malfunctions should include:</p> <ul style="list-style-type: none"> - undercharged systems - restricted systems - overcharged systems - low compressor capacity - moisture in the system - air in the system - excessive heat load - inefficient condenser - incorrect superheat <p>Recommendations will be made for replacement or repair of the assembly. Troubleshooting procedures will be done safely, with minimum disruption and no additional damage to the system. Associated heating system malfunctions may be identified without recommendations for repair.</p>

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	<ul style="list-style-type: none"> - distribution controls - refrigerant controls - motor controls - temperature and humidity controls - pressure regulators - limit controls - defrost and deice controls - overload and safety controls - Select and operate leak detectors - Select and operate required measuring and checking instruments - Measure and check all system parameters - Calculate heat load - Read prints, schematics, graphs, charts and tables 		

SPECIFIC PERFORMANCE OBJECTIVES AND CRITERIA FOR :

REFRIGERATION AND AIR CONDITIONING MECHANIC

CCDO No.

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<p>REPAIR:</p> <ul style="list-style-type: none"> - ROTARY COMPRESSOR ASSEMBLIES <p>of the following types:</p> <ul style="list-style-type: none"> - air-cooled - water-cooled - refrigerant-cooled - open - hermetic <p>NOTE:</p> <p>The above types include:</p> <ul style="list-style-type: none"> - rotary blade - stationary blade <p>The above assemblies include the following components:</p> <ul style="list-style-type: none"> - compressor - valves and couplings - drive motor and assembly - controls 	<ul style="list-style-type: none"> - Read prints, schematics, graphs, charts and tables - Start and shut-down the system - Identify the components and determine the fundamentals of operation of each - Assemble and disassemble the compressor - Operate the required tool and equipment for: <ul style="list-style-type: none"> - assembly and disassembly - evacuation and charging - the specified repair work - Apply the correct methods to repair the specified compressor assemblies, such as: <ul style="list-style-type: none"> - brazing and soldering - refastening and realigning - replacement of: <ul style="list-style-type: none"> - motor compressor system - valve plates - seals - repair or replacement of electrical wiring or controls - replacement of the assembly - Select the replacement components - Operate the correct measuring instruments for: <ul style="list-style-type: none"> - checking, testing, and measuring electrical circuits - mounting and aligning components - liquid temperature, pressure and flow - vapor temperature and pressure - Calculate volumetric efficiency 	<p>The source of the malfunction must be established.</p> <p>The rotary compressor assembly will be repaired or replaced safely with minimal disruption to the system.</p> <p>All the specified repair operations on rotary compressor assemblies will:</p> <ul style="list-style-type: none"> - be within regulations and codes governing the wiring and controls - have no leakage in the: <ul style="list-style-type: none"> - oil lines - coolant lines - refrigerant lines - water jacket - valves - maintain correct suction and discharge pressures and temperatures - have minimal noise and vibration - have proper oil circulation and lubrication - maintain maximum volumetric efficiency <p>Apply the refrigerant cleanout procedures to prevent further compressor burnouts and contamination.</p>

SPECIFIC PERFORMANCE OBJECTIVES AND CRITERIA FOR: REFRIGERATION AND AIR CONDITIONING MECHANIC			CCDO No.
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REPAIR: - RECIPROCATING COMPRESSOR ASSEMBLIES of the following types: - open - hermetic - semi-hermetic - two stage - halocarbon - ammonia NOTE: These types include: - single cylinder - multi-cylinder - air-cooled - water-cooled - refrigerant-cooled The above assemblies include the following components: - compressor - controls - valves and couplings - drive motor and assembly	- Read prints, schematics, graphs, charts and tables - Start and shut-down the system - Identify the components and determine the fundamentals of operation of each - Assemble and disassemble the compressor - Operate the required tools and equipment for: - assembly and disassembly - evacuation and charging - the specified repair work - Apply the correct methods to repair the specified compressor assemblies such as: - brazing and soldering - refastening and realigning - replacement of: - seals - gaskets - valve plates - repair or replacement of electrical wiring or controls - replacement of the assembly - Select the replacement components - Operate the correct measuring instruments for checking, testing and measuring:	The source of the malfunction must be established. The reciprocating compressor assembly will be repaired or replaced safely with minimal disruption to the system. All the specified repair operations on reciprocating compressor assemblies will: - be within the regulations and codes governing the wiring and controls - have no oil, refrigerant and coolant leakage - maintain the correct suction and discharge pressures - have minimal noise and vibration - have proper oil circulation and lubrication Apply the refrigerant cleanout procedures to prevent further compressor burnouts and contamination.	

SPECIFIC PERFORMANCE OBJECTIVES AND CRITERIA FOR : REFRIGERATION AND AIR CONDITIONING MECHANIC			CCDO No.
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	<ul style="list-style-type: none"> - leakage in pertinent areas - oil, vapor and coolant temperature - pressure and compression - electrical circuits and controls - mounting and alignment of components - liquid flow - calculate volumetric efficiency - drain and flush the water jacket and coolant lines 		

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TERMINAL PERFORMANCE OBJECTIVES : To be able to...	ENABLING OBJECTIVES : Will be able to...	TERMINAL PERFORMANCE CRITERIA : Minimum acceptable standard...	
<p>REPAIR:</p> <ul style="list-style-type: none">- CENTRIFUGAL COMPRESSOR ASSEMBLIESof the following types:- water-cooled- refrigerant-cooled- open- hermetic- single and multiple stage- ammonia- halocarbon <p>NOTE:</p> <p>The above assemblies include the following components:</p> <ul style="list-style-type: none">- compressor- valves, seals and couplings- drive motor and assembly- controls- electrical wiring	<ul style="list-style-type: none">- Read prints, schematics, graphs, charts and tables- Start and shut-down the system- Identify the components and determine the fundamentals of operation of each- Assemble and disassemble the compressor- Apply the correct methods to repair the specified compressor assemblies, such as:<ul style="list-style-type: none">- brazing and soldering- refastening and realigning- replacement of:<ul style="list-style-type: none">- motor compressor system- seals- bearings- repair or replacement of electrical wiring or controls- Operate the required tools and equipment for:<ul style="list-style-type: none">- assembly and disassembly- evacuation and charging- the specified repair work- Select the replacement components- Operate the correct measuring instruments for:<ul style="list-style-type: none">- checking, testing and measuring electrical circuits- mounting and aligning components- liquid temperature, pressure and flow- vapor temperature and pressure- Drain and flush the water jacket and coolant lines	<p>The source of the malfunction must be established.</p> <p>The centrifugal compressor assembly will be repaired or replaced safely with minimal disruption to the system.</p> <p>All the specified repair operations or centrifugal compressor assemblies will:</p> <ul style="list-style-type: none">- be within regulations and codes governing wiring and controls- have no leakage in the:<ul style="list-style-type: none">- oil lines- coolant lines- refrigerant lines- water jacket- valves and seals- maintain the correct pressure and temperature differences for suction and discharge- have minimal noise and vibration- have proper oil circulation and lubrication <p>Apply the refrigerant cleanout procedures to prevent further compressor burnouts and contamination.</p>	

SPECIFIC PERFORMANCE OBJECTIVES AND CRITERIA FOR : REFRIGERATION AND AIR CONDITIONING MECHANIC CCDO No.		
TERMINAL PERFORMANCE OBJECTIVES : To be able to ...	ENABLING OBJECTIVES : Will be able to ...	TERMINAL PERFORMANCE CRITERIA : Minimum acceptable standard ...
REPAIR: - CONDENSER ASSEMBLIES of the following types: - air-cooled - water-cooled - evaporative NOTE: The above assemblies include the following components: - coil - receiver - valves (including water regulating) - fan - drive motor and controls - pipes and fittings	<ul style="list-style-type: none"> - Read prints, charts and schematics - Apply the correct methods to repair the specified types of condenser assemblies, such as: <ul style="list-style-type: none"> - brazing and soldering - reinstalling - cleaning, combing and realigning of fins - repair or replacement of electrical wiring and controls - replacement of component parts - cleaning, draining and flushing of piping and tubing - Identify the components and determine the fundamentals of operation of each - Select replacement components - Operate the applicable tools, fasteners and measuring instruments - Isolate the malfunction accurately - Shut-down and start-up the system - Evacuate and charge the system - Repair or replace water regulating valves 	<p>The source of the malfunction must be identified.</p> <p>The condenser assembly will be repaired or replaced safely with minimal disruption to the system.</p> <p>All the specified repair operations on the condenser assemblies must:</p> <ul style="list-style-type: none"> - maintain the maximum refrigerant liquidation - have total heat dispersion in the cooling medium - be within the regulations and codes governing the wiring and controls - have the required fin spacing and alignment - have maximum coolant and refrigerant circulation - maintain minimal noise and vibration - have no leakage or obstruction in the tubing, piping and fittings - result in maximum air flow - result in optimum water flow - determine the condition of the water regulating valve

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<p>REPAIR:</p> <ul style="list-style-type: none">- EVAPORATOR ASSEMBLIES of the following types:- air-cooling- liquid-cooling (chiller) <p>NOTE:</p> <p>Chillers of the following types:</p> <ul style="list-style-type: none">- water- brine- product <p>The above assemblies include the following components:</p> <ul style="list-style-type: none">- coil- valves and couplings- fan- drive motor and controls- defrost apparatus	<ul style="list-style-type: none">- Read prints, charts and schematics- Apply the correct methods to repair the specified types of evaporator assemblies, such as:<ul style="list-style-type: none">- brazing and soldering- refastening- combing or realigning of fins- repair or replacement of electrical wiring or connections- replacement of component parts- defrosting or deicing the coils- cleaning, draining and flushing of piping and tubing- Identify the components and determine the fundamentals of operation of each- Select replacement components- Operate the applicable tools, fasteners and measuring instruments- Isolate the malfunction accurately- Shut-down and start-up the system- Evacuate and charge the system	<p>The source of the malfunction must be identified.</p> <p>The evaporator assembly will be repaired or replaced safely with minimal disruption to the system.</p> <p>All the specified repair operations on the evaporator assemblies will:</p> <ul style="list-style-type: none">- have the required fin spacing and alignment- maintain the maximum specified heat transfer- be within the regulations and codes governing the wiring and controls- have no leakage in the tubing and fittings- remove all ice and build-up on the coil- maintain the correct cycle for the operation and defrost	

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REPAIR: - DEFROST SYSTEMS of the following types: - conventional system shut-down - hot gas - water spray - electric heater - brine spray	<ul style="list-style-type: none"> - Read prints, schematics, charts and tables - Start and shut-down the system - Operate the correct tools and equipment for: <ul style="list-style-type: none"> - connecting and disconnecting defrosting apparatus - flushing and cleaning liquid lines and pipes - repair and replacement of system components such as: <ul style="list-style-type: none"> - timers and controls - valves, pipes and fittings - re-evaporator coil - electrical wiring - Operate the correct measuring instruments for: <ul style="list-style-type: none"> - air and water temperature - electrical circuits and controls - detecting and isolating leaks - Adjust the timer controls - Operate the valves correctly to implement the defrost system - Identify the components and determine the fundamentals of operation of each - Apply the methods of repair of multiple evaporator systems to maximize the system operation during the defrosting cycle 	<p>The source of the malfunction must be established. The defrosting system will be repaired or replaced safely with minimal disruption to the main system. All repair operations on the defrosting system will:</p> <ul style="list-style-type: none"> - be within the regulations and codes governing the wiring and controls - maintain the correct on/off cycle of the system - ensure no liquid refrigerant drainage into the compressor - ensure no leakage of refrigerant or the defrosting agent - ensure complete melting and drainage of ice and frost build-up - ensure proper water or brine circulation - have minimal air movement through the evaporator coil

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REPAIR: - CONTROL VALVES of the following types: - electric - automatic - manual	<ul style="list-style-type: none"> - Read prints, charts and tables - Evacuate and charge the system - Start and shut-down the system - Operate the correct tools and equipment for: <ul style="list-style-type: none"> - removing the valves from the system - disassembling and assembling the valves - replacing the valve in the system - adjusting the control - Operate the correct measuring instruments for: <ul style="list-style-type: none"> - temperature - pressure - liquid levels - electric circuits - Repack the valves after the repair - Clean, flush and drain the valves - Lubricate all necessary areas 	<p>The source of the malfunction must be established. The control valves will be repaired or replaced safely with minimal disruption to the system. All the repair operations on control valves will:</p> <ul style="list-style-type: none"> - ensure no leakage - maintain ease of operation (manual) - maintain correct pressures, temperatures and liquid flow in the regulated areas - ensure the required pressure drop across the valves 	

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REPAIR: - METERING DEVICES of the following types: - capillary tube - automatic expansion valve - thermostatic expansion valve - hand operated expansion valve - low-pressure float valve - high-pressure float valve	<ul style="list-style-type: none"> - Read charts, tables and schematics - Evacuate and charge the system - Start and shut-down the system - Operate the tools and equipment for: <ul style="list-style-type: none"> - evacuation and charging - removing the metering device from the system - replacing a component of the device - adjusting necessary parts - replacing the device in the system - Operate the measuring instruments for: <ul style="list-style-type: none"> - temperature - pressure - testing float valves for the correct operation - Clean, flush and purge the metering devices - Lubricate all moving parts - Select the correct replacement components 	<p>The source of the malfunction must be established. The metering devices will be repaired or replaced safely with minimal disruption to the system. All repair operations on metering devices will:</p> <ul style="list-style-type: none"> - ensure no leakage - maintain correct pressure in the refrigerant lines and the evaporator - maintain the correct sub-cooling temperatures

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REPAIR: - SYSTEM CONTROLS of the following types: - thermostats - pressurestats - humidistats	<ul style="list-style-type: none"> - Read schematics and diagrams - Assemble and disassemble all the specified system controls - Operate the controls by adjusting them manually - Identify the components of the controls and determine the fundamentals of operation of each - Select and operate the correct tools for the repair operation - Select and operate the proper measuring instruments to isolate the malfunction - Employ a methodical troubleshooting service analysis - Determine the tolerance range for the control setting - Select the correct replacement components 	<p>The source of the malfunction must be isolated. The system controls will be repaired or replaced safely with minimal disruption to the system. All repair operations on system controls will:</p> <ul style="list-style-type: none"> - ensure proper electrical wiring and connections - maintain the proper: <ul style="list-style-type: none"> - temperature - humidity - pressure - within the specified tolerance range 	

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TERMINAL PERFORMANCE OBJECTIVES : To be able to...	ENABLING OBJECTIVES : Will be able to...	TERMINAL PERFORMANCE CRITERIA : Minimum acceptable standard...
REPAIR: - AIR HANDLING AND DISTRIBUTION EQUIPMENT of the following types: - single zone - multi-zone - air induction - water induction - conventional NOTE: The above equipment includes the following components: - blower fan assembly - duct system - registers, grills, dampers - diffusers - humidifier and dehumidifier assemblies - air cleaning assembly - exhaust hoods - mixing chamber - heating and cooling coils - controls	- Read prints, graphs, charts, schematics and tables - Operate the correct tools and equipment for: - assembly and disassembly of: - the system components and assemblies - electrical components - the disconnection and replacing of ductwork to expose the defective components - replacement of assemblies and components - Operate the correct measuring instruments for: - air flow - electrical circuits - humidity - temperature - sound level of the blower fan - Start and shut-down the system - Adjust registers, grills, dampers and diffusers for: - the required fresh air and recirculated air mixture - acceptable air velocity and direction in each individual area - balancing the air flow for correct dispersion - Adjust the electrical and mechanical controls - Identify all the assemblies, components and system components and determine the fundamentals of operation of each	The source of the malfunction must be established. The components of the air handling and distribution equipment must be repaired or replaced with minimal disruption to the system. There must be minimal noise and vibration during operation. The air flow must maintain circulation but not produce a draft effect. The desired temperature and relative humidity must be maintained in all zones. There must be no leakage of air or water throughout the system. The conditioned air must have maximum cleanliness from dust, dirt and smoke. There must be a minimal amount of heat transfer in ductwork.

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	<ul style="list-style-type: none"> - Insulate pipes, tubing and ductwork - Calculate air mixtures, heat transfers and humidity requirements - Replace bearings in fan 			

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REPAIR: - HUMIDIFIER ASSEMBLIES of the following types: - spray-type air washers - evaporative pan - electrically operated - air operated - rotating drum NOTE: The above assemblies include the following components: - water or steam holding tank - valves and couplings - piping and tubing - fan - drive motor and controls - temperature controls - humidity controls - pump assembly	- Read prints, schematics, charts and graphs - Apply the correct methods to repair or replace humidifier assemblies - Identify the components and determine the fundamentals of operation of each - Operate the correct tools to perform: - the assembly and disassembly - the necessary repair or replacement - draining, flushing and cleaning - Operate the correct measuring instruments for: - humidity - temperature - air and water flow - leakage - electrical circuits and controls - Select the replacement components - Select the proper chemicals and additives for: - corrosion - algae build-up - scale build-up - Drain, flush and clean the water system	The source of the malfunction must be established. The humidifier assembly will be repaired or replaced safely with minimal disruption to the system. All specified repair operations on humidifier assemblies will: - ensure the required air flow - have minimal noise and vibration during operation - maintain the necessary assembly cut-off cycle (humidistat control) - ensure the proper water circulation - maintain proper operation of pressure and float valves - ensure maximum distribution of water into the air - ensure no leakage - ensure a clean tank	

SPECIFIC PERFORMANCE OBJECTIVES AND CRITERIA FOR : REFRIGERATION AND AIR CONDITIONING MECHANIC C C D O No.		
TERMINAL PERFORMANCE OBJECTIVES : To be able to ...	ENABLING OBJECTIVES : Will be able to ...	TERMINAL PERFORMANCE CRITERIA : Minimum acceptable standard ...
REPAIR: - AIR CLEANER ASSEMBLIES of the following types: - electronic - air washer - filters (dry and viscous) NOTE: The above assemblies include the following components: - filter - recirculating pump - heat exchanger - wiring and controls - washer nozzles and holding tank	<ul style="list-style-type: none"> - Read prints, schematics and charts - Assemble and disassemble the air cleaner - Operate the correct tools and equipment for: <ul style="list-style-type: none"> - removal from the system - replacement in the system - assembly and disassembly - replacement of a component - cleaning the holding tank and lines - electrical repair or replacement - Operate the correct measuring instruments for: <ul style="list-style-type: none"> - water temperature and flow - air flow - electrical circuits and controls - Start and operate the assembly - Select the replacement components - Select additives to minimize: <ul style="list-style-type: none"> - corrosion - algae build-up - scale build-up - Clean filters using the proper equipment 	<p>The source of the malfunction must be established. The specified types of air cleaners will be repaired or replaced safely with minimal disruption to the system. All specified repair operations will:</p> <ul style="list-style-type: none"> - maintain required air circulation - remove the maximum amount of dirt and smoke from the air - maintain proper water circulation - ensure a secure mounting in the system - ensure correct filter bank installation

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REPAIR: - COOLING TOWER ASSEMBLIES of the following types: - forced draft - natural draft - induced draft NOTE: The above assemblies include the following components: - pump - piping and valves - basin - fan and drive motor - controls - spray nozzles and decks	- Apply the correct methods to repair or replace water-cooling towers - Assemble and disassemble the tower - Identify the component parts and the fundamentals of operation of each - Operate the correct tools and equipment for: - assembly and disassembly - the specified repair work - draining and flushing the assembly - Operate the correct measuring instruments for: - air temperature and flow - water temperature and flow - electrical circuits and controls - checking for water leakage - water loss through recirculation - Select the replacement components - Select the proper chemicals and additives to prevent: - corrosion - algae build-up - scale build-up - Clean, drain and flush the water-cooling tower assembly	The source of the malfunction must be established. The water-cooling tower assembly will be repaired or replaced safely with minimal disruption to the system. All the specified repair operation on water-cooling tower assemblies will: - maintain the proper water flow - maintain alignment of the individual decks - be within the regulations and codes governing the wiring and controls - have no water leakage - maintain the correct fan operation - have the proper air circulation - maintain the proper water temperature - maintain minimum loss of water - maintain a rigid mounting

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REPAIR: - ICE MAKER ASSEMBLIES of the following types: - vertical tube - rotating drum NOTE: The above assemblies include the following components: - ice makers - piping and tubing - valves and couplings - defrosting apparatus - scoring, crushing or cubing equipment - storage tanks and rooms - electrical wiring and controls	<ul style="list-style-type: none"> - Read prints, schematics, graphs, charts and tables - Determine the correct methods to repair the ice maker assembly - Operate the correct tools and equipment for: <ul style="list-style-type: none"> - assembly and disassembly - repair or replacement of the components - removing the ice and ice build-up - evacuation of necessary liquids - cleaning and flushing of tubing - Operate the correct measuring instruments for: <ul style="list-style-type: none"> - checking, testing and measuring the wiring and controls - liquid and air temperatures and flow rates - dimensions and density of the frozen product - Select the replacement components - Select the correct additives for: <ul style="list-style-type: none"> - clear ice - hardening the ice - corrosion - scale build-up - Adjust the scoring, crushing and cubing equipment for the required markings and shape of the ice 	<p>The source of the malfunction must be established.</p> <p>The ice maker assembly will be repaired or replaced safely with minimal disruption to the system.</p> <p>All the specified repair operations on ice maker assemblies will:</p> <ul style="list-style-type: none"> - ensure the proper ice removal to the storage area - maintain the correct operating temperatures in: <ul style="list-style-type: none"> - the cooling medium - storage area - produce the desired shape of ice - ensure total freezing in the specified cycle - ensure correct air, water and coolant circulation - maintain correct time and capacity cycles

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REPAIR: - CIRCULATING PUMP ASSEMBLIES of the following types: - centrifugal - positive displacement NOTE: The above types include the following components: - the pump assembly - drive mechanism and assembly - wiring and controls - valves, seals and couplings	<ul style="list-style-type: none"> - Read prints, schematics, charts and tables - Start and shut-down the system - Connect and disconnect the pump from the system - Operate the correct tools and equipment for: <ul style="list-style-type: none"> - connecting and disconnecting the hoses, tubing and wiring - the replacement of a faulty component - cleaning and lubricating the moving parts - Operate the correct measuring instruments for: <ul style="list-style-type: none"> - aligning the assembly and components - electrical wiring and controls - liquid flow rates, volume and pressure - detection and isolation of leaks - Prime the pump - Select the replacement components - Calculate the available net positive suction head 	<p>The source of the malfunction must be established.</p> <p>The pump assembly will be repaired or replaced safely with minimal disruption to the system.</p> <p>All the repair operations of circulating pump assemblies will:</p> <ul style="list-style-type: none"> - ensure no leakage - be within the regulations and codes governing the wiring and controls - ensure the required net positive suction head to prevent vaporization - maintain proper pumping capacity and the specified velocity - ensure minimal noise and vibration - ensure proper priming before operation to prevent further damage - maintain maximum transfer of power

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REPAIR: - HEAT PUMP SYSTEMS of the following types: - air to air - water to air NOTE: Heat pump systems contain the following: - compressor assembly - outdoor coil assembly - indoor coil assembly - pipes and tubing - valves and couplings - wiring and controls - indoor fan assembly - electric resistance heaters	<ul style="list-style-type: none"> - Read prints, charts, tables, graphs and schematics - Start and shut-down the system - Evacuate, purge and charge the system - Assemble and disassemble component parts of the system - Operate the correct tools and equipment for: <ul style="list-style-type: none"> - replacement of assemblies or component parts - replacement of the system - assembly, disassembly, evacuating, purging, and charging - the repair of leaks - Operate the correct measuring instruments for: <ul style="list-style-type: none"> - relative humidity - air, water and refrigerant temperature and flow - electrical circuits and controls - detecting leaks - Identify the component assemblies and parts, and determine the fundamentals of operation of each component - Operate the controls to accomplish: <ul style="list-style-type: none"> - heating - cooling - defrosting 	<p>The source of the malfunction must be established.</p> <p>The heat pump will be repaired or replaced safely with minimal disruption.</p> <p>All repair operations on the heat pump system will:</p> <ul style="list-style-type: none"> - ensure the correct cycle for heating, cooling and defrosting - be within the codes and regulations governing the wiring and controls - ensure no leakage of refrigerant - maintain the set temperature in the occupied space - ensure proper air or water circulation through the coils - ensure minimal noise and vibration during operation - ensure that operating pressures and temperature in the refrigeration cycle are in accordance with the manufacturer's specifications - ensure that the refrigerant charge is correct - identify problems related to electrical supply, or air handling systems, as well as problems in the heat pump unit

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REPAIR: - CENTRAL RESIDENTIAL AIR CONDITIONING SYSTEMS of the following types: - packaged - split	<ul style="list-style-type: none"> - Read prints, graphs, schematics, charts and table - Shut-down and start the system - Operate the necessary tools and equipment to complete the repair - Operate the required measuring instruments to isolate the malfunction - Repair or replace the following system components: <ul style="list-style-type: none"> - the evaporator assembly - the condenser assembly - the compressor assembly - piping and tubing - control valves and electrical controls - metering devices - Identify the system components and determine the fundamentals of operation of each - Determine and apply the most suitable procedures to repair the system, such as: <ul style="list-style-type: none"> - replacing filters, driers, gaskets - repairing leaks - purging the system - defrosting - replacing faulty components - lubrication of the necessary areas - Troubleshoot the system by employing a methodical service analysis - Select the correct replacement components 	<p>The source of the malfunction must be isolated.</p> <p>The air conditioning system will be repaired safely with minimal disruption to the immediate environment.</p> <p>All repair operations on the system will:</p> <ul style="list-style-type: none"> - ensure no leakage - maintain proper condenser ventilation - ensure the proper system control operations for: <ul style="list-style-type: none"> - temperature - humidity - defrost - ensure correct air flow and distribution in single and multi-zone units - maintain minimal noise and vibration during operation - be done according to the pertinent codes and regulations

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REPAIR: - ABSORPTION SYSTEMS of the following types: - liquid absorbent - solid absorbent NOTE: The above systems include the following components: - generator - separator - gas and liquid heat exchanger - absorber - condenser - evaporator - defroster - system controls - valves, piping and tubing - pumps - rectifier - analyzer	<ul style="list-style-type: none"> - Read prints, schematics, graphs, charts and tables - Start and shut-down the system - Operate the necessary tools and equipment to complete the repair - Select and operate the required measuring instruments to isolate the malfunction - Identify the system components and determine the fundamentals of operation of each - Troubleshoot the system by employing a methodical service analysis - Determine and apply the most suitable methods to repair the system, such as: <ul style="list-style-type: none"> - replacement of a system component - repairing leaks - setting controls for proper cycles - cleaning, draining and flushing of piping and tubing - fin cleaning of the condensor and the evaporator - removing soot deposits - Select the proper replacement components - Adjust air and water flow controls 	<p>The source of the malfunction must be isolated. The absorption system will be repaired safely with minimal disruption.</p> <p>All repair operations on the system will:</p> <ul style="list-style-type: none"> - ensure no leakage - maintain the proper heating of the generator by: <ul style="list-style-type: none"> - steam - gas - electricity - ensure the proper system control operations for: <ul style="list-style-type: none"> - temperature - humidity - defrost - maintain minimal noise and vibration during operation - be done according to local codes and regulations - maintain proper cooling temperatures - ensure correct air flow and distribution in single and multi-zone units

